

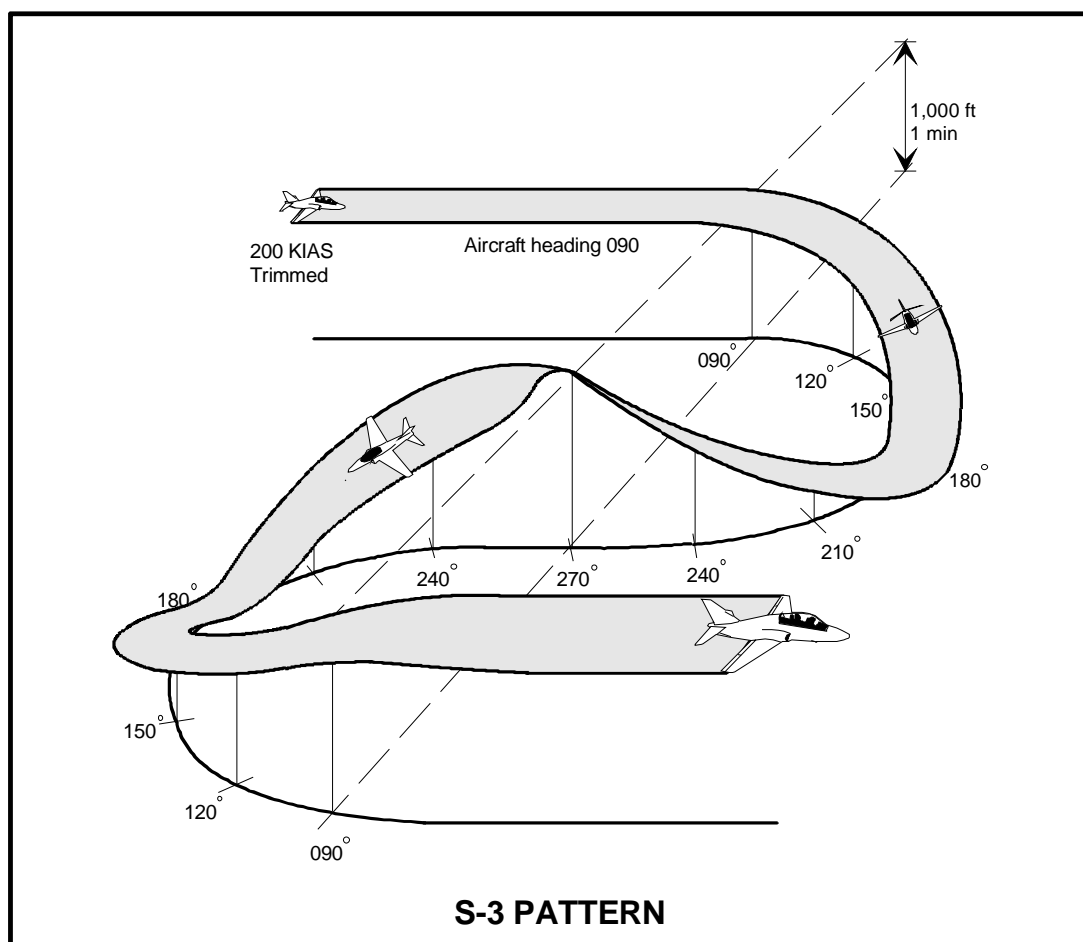
NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS

CNATRA P-1285 (REV. 8-99) PAT



BASIC INSTRUMENTS FLIGHT PROCEDURES



LESSON GUIDE

1999

T-45C FLIGHT SUPPORT LECTURE GUIDE

CHANGE SUMMARY PAGE

CHANGE NUMBER	DATE ENTERED	CHANGE DESCRIPTION	INITIALS

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LESSON GUIDE

LIST OF EFFECTIVE PAGES

EFFECTIVE PAGES	PAGE NUMBERS	EFFECTIVE PAGES	PAGE NUMBERS
FRONT MATTER Original	i thru iv		
TS & ADV BIFP-02 Original Original	2-i thru 2-ii 2-1 thru 2-14		
TS & ADV BIFP-03 Original Original	3-i thru 3-ii 3-1 thru 3-10		
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LESSON GUIDE

COURSE/STAGE: T-45C TS & ADV Basic Instruments Flight Procedures

LESSON TITLE: Introduction to Basic Instruments

LESSON IDENTIFIER: T-45C TS & ADV BIFP-02

LEARNING ENVIRONMENT: CAI

ALLOTTED LESSON TIME: 0.7 hr

TRAINING AIDS:

- * Figures
- Fig 1: Instrument Locations

STUDY RESOURCES:

- * NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
- * T-45C Instrument FTI

LESSON PREPARATION:

Read:

- * Chapters 13, 14, 15, and 16 in the NATOPS Instrument Flight Manual, NAVAIR 00-80T-112

REINFORCEMENT: N/A

EXAMINATION:

The objectives in this lesson will be tested in TS and ADV BIFP-10X.

(8-99) ORIGINAL

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LESSON OBJECTIVES**1.4.5.3.1.3**

Identify the location, purpose, and function of the flight control instruments

1.4.5.3.1.2

Identify the location, purpose, and function of the flight performance instruments

1.4.5.3.1.4

Identify the location, purpose, and function of the flight position instruments

2.5.12.1.1

Recall instrument scan procedures/techniques

2.7.8

Demonstrate procedures for entering instrument mission data into display system

MOTIVATION

You should gain a sound understanding of basic instrument flying early in your training. The Basic Instrument lessons that you are about to take will provide you with the necessary information you need to master the complexities of instrument flight.

This lesson covers the location, purpose, and use of the cockpit instruments and how to scan them in the most efficient matter. Later in the curriculum, you will learn to apply this information to operate safely in low visibility environments.

OVERVIEW

This lesson provides an overview to prepare you for using basic instruments. Later study sessions and hands-on lessons will address transitions, instrument turns, “S” patterns, TACAN/VOR procedures, instrument failures, partial panel techniques, stalls and unusual attitudes.

In this lesson, we will study:

- * Control instruments (attitude)
- * Control instruments (power)
- * Performance instruments
- * Position instruments
- * Basic instrument scan
- * Entering instrument mission data

As you move through the lesson, note that some instruments have multiple functions and, therefore, appear in two or more categories (e.g., the ADI).

PRESENTATION**LESSON NOTES**

Figure 1 contains a cockpit diagram with the placement of all flight instruments mentioned in this lesson. Please refer to it as necessary for finding the location of these instruments.

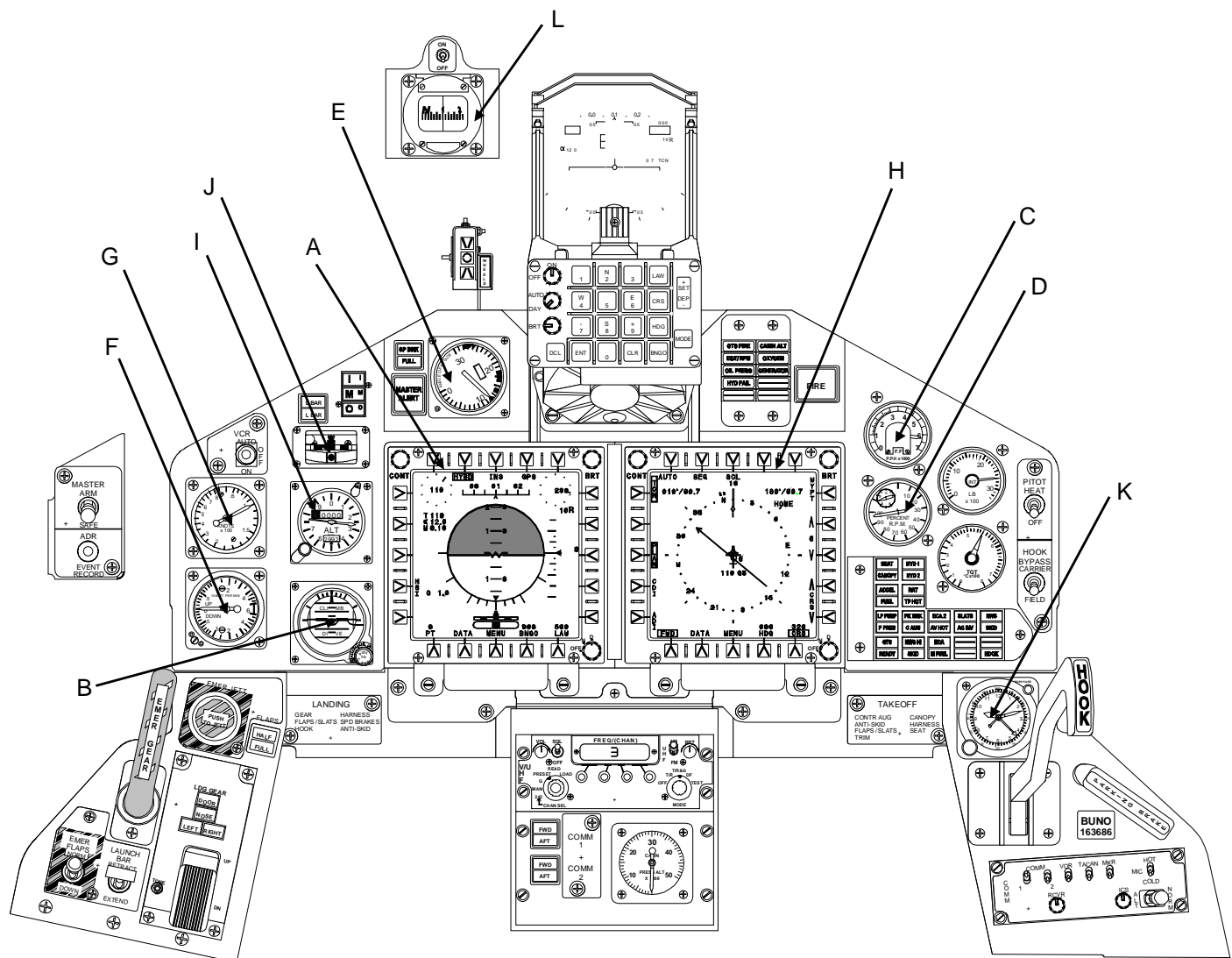
Fig 1: Instrument Locations

I. Control instruments 1.4.5.3.1.3**A. Attitude instruments**

1. Attitude director indicator (ADI)
 - a. Location: normally on the left MFD
 - b. Purpose: primarily source of pitch, bank, and heading information
2. Standby attitude indicator
 - a. Location: left of the left MFD
 - b. Purpose:
 - (1) Used as backup gyro if ADI is disabled
 - (2) Used as cross-check of main ADI

B. Power instruments

1. Fuel flow indicator
 - a. Location: on upper right side of instrument panel



- | | |
|----------------------------|-------------------------------------|
| A. ADI | D. RPM Indicator |
| A. Angle of Attack | E. Angle of Attack Indicator |
| A. Vertical Velocity | F. Standby Vertical Speed Indicator |
| A. Airspeed | G. Standby Airspeed Indicator |
| A. Altitude | H. HSI |
| A. Radar Altitude | I. Standby Pressure Altitude |
| A. Turn and Slip Indicator | J. Standby Turn and Slip Indicator |
| B. Standby AI | K. Clock |
| C. Fuel Flow Indicator | L. Standby Compass |

Figure 1: INSTRUMENT LOCATIONS

b. Purpose:

- (1) Used as control instrument for power
- (2) Calibrated to show fuel flow rates in hundreds of pounds per hour (pph)

2. RPM indicator

a. Location: on upper right side of instrument panel

b. Purpose:

- (1) Displays percentage of maximum rpm

NOTE: The engine rpm indicator does not display total thrust or actual engine rpm; it shows percentage of maximum rpm.

- (2) Initially included in scan to determine correct power settings

II. Performance instruments **1.4.5.3.1.2**

A. ADI (directional gyro)

1. Location: normally on the left MFD
2. Purpose:
 - a. Displays continuous magnetic heading information
 - b. Used as primary heading reference

B. Altitude

1. Pressure altitude
 - a. Location: on the ADI display
 - b. Purpose:
 - (1) Used to verify aircraft altitude

- (2) Displays climb, descent, or level flight indications and is cross-checked for nose attitude in most maneuvers

2. Standby pressure altimeter

- a. Location: left side of the instrument panel

- b. Purpose:

- (1) Standby altitude information and cross-check altitude on ADI display

- (2) Set system barometric pressure

C. Vertical velocity

1. Vertical velocity indication

- a. Location: on the ADI display

- b. Purpose:

- (1) Displays the rate of climb or descent in feet per minute (fpm)

- (2) Used to verify level flight and monitor constant rate climbs/descents

- (3) Used to verify pitch attitude

2. Standby vertical speed Indicator

- a. Location: left side of the instrument panel

- b. Purpose: Standby vertical speed indication and cross-check of vertical speed on ADI display

D. Airspeed and Mach

1. Airspeed and Mach indications

- a. Location: on the ADI display

b. Purpose:

(1) Airspeed indication

- (a) Displays indicated airspeed in knots
- (b) Used as performance indicator for power and pitch

(2) Mach indication

- (a) Displays mach in hundredths
- (b) Used as performance indicator for cruise flight

2. Standby airspeed indicator

- a. Location: left side of the instrument panel
- b. Purpose: Standby airspeed indication and cross-check of the airspeed indication on the ADI display

E. Turn and slip

1. Turn and slip indication

- a. Location: on the ADI display
- b. Purpose:
 - (1) Turn indicator displays turn rate relative to standard rate (3 degrees/seconds)
 - (2) Slip indicator shows degree of flight coordination
 - (a) Ball deflection in the direction of the turn indicates a slip
 - (b) Ball deflection in the opposite direction of the turn indicates a skid

2. Standby turn and slip indicator

- a. Location: left side of the instrument panel
- b. Purpose: Standby turn and slip indication and cross-check of the turn and slip indication on the ADI display

F. HSI (magnetic heading)

- 1. Location: normally on the right MFD
- 2. Purpose:
 - a. Used as secondary heading instrument
 - b. Used to cross-check ADI heading information

G. Standby compass

- 1. Location: center of canopy above windshield
- 2. Purpose:
 - a. Displays magnetic heading
 - b. Used when ADI and HSI heading inoperative
 - c. Used as cross-check for ADI and HSI heading

H. Angle of attack

- 1. Angle of attack indication
 - a. Location: on the ADI display
 - b. Purpose:
 - (1) Read primarily to set specific performances parameters
 - (2) Shows angle of attack regardless of weight, g-load, and lift configuration

(3) Can be used to optimize performance for a phase of flight

(a) Maximum endurance -- 14 units

(b) Maximum range -- 12 to 13 units

2. Angle of attack indicator

a. Location: on the left of the instrument panel

b. Purpose: used to cross-check ADI angle of attack information

I. Clock

1. Location: lower right of flight instrument group on right instrument panel

2. Purpose:

a. Used on some constant rate maneuvers

(1) Timed turns

(2) Holding patterns

III. Position instruments **1.4.5.3.1.4**

A. HSI (bearing points)

1. Location: normally on the right MFD

2. Purpose: displays magnetic bearing for a selected steering option to a tuned VOR/TACAN station or active waypoint relative to the steering source

B. HSI (Planimetric or Course Deviation Indication)

1. Purpose:

- a. Displays aircraft heading
- b. Shows aircraft position relative to selected course
- c. Provides secondary ILS course information when ILS is the selected steering option

C. HSI (TACAN and Waypoint data block)

1. Location: on the HSI display
2. Purpose: displays bearing, slant range between TACAN or VOR/DME station or straight line range to a waypoint and the aircraft, and time to go at the current ground speed

D. ADI (glideslope and azimuth deviation bars)

1. Location: on the ADI display
2. Purpose: provide glideslope and primary course information during an ILS approach

E. Pressure altitude

1. Location: on the ADI display
2. Purpose:
 - a. Displays aircraft altitude in reference to a standard plane (sea level)
 - b. Indicates climbs and descents
 - c. Primary verification for pitch attitude for most maneuvers

F. Radar altitude

1. Location: on the ADI display
2. Purpose:
 - a. Provides visual and audio warning at selected altitudes
 - b. Displays aircraft altitude above terrain (AGL)

IV. Scan techniques **2.5.12.1.1**

- A. Traditional and modified spoke scan: Distributes pilot's time among all or most flight instruments with the ADI as the hub of the scan
- B. Maneuver-specific scan
 1. ADI is primary control instrument for transitions
 2. Digital cockpit scan simplified because performance indications are located on the ADI display
 3. Method requires knowledge of what instruments are necessary to perform the maneuver (e.g., straight and level, roll-in, maintain turn, roll-out, etc.)
 4. Emphasis placed on ADI with performance instruments cross-checked for desirable/undesirable readings
 5. More efficient and emphasizes specific instruments

V. Entering instrument mission data **2.7.8**

- A. On start system navigation information initializes to:
 1. Navigation control -- forward cockpit
 2. HSI display -- Planimetric
 3. No steering selected

4. Command course -- 000 and boxed
5. Low altitude warning -- 500 feet
6. Waypoint -- 0
7. Compass rose scale -- 40 nm
8. Command heading -- 000
9. Bingo -- 900 lbs

B. Entering mission data

1. Set navigation control to the desired cockpit to control:
 - a. HSI display mode
 - b. VOR/ILS and TACAN channel
 - c. Command heading and course
 - d. Waypoint
 - e. Steering reference
 - f. Compass rose scale
2. Select desired HSI display: Planimetric or CDI
3. Select desired steering: TCN, VOR or WYPT
4. Select desired parameters for:
 - a. Command course
 - b. Command heading
 - c. Compass rose scale
 - d. Low altitude warning
 - e. BINGO

CONCLUSION

Basic instrument knowledge and flying skills will be your best defense against adverse weather and poor visibility conditions that require your attention both inside and outside the cockpit.

Even with the best weather and visibility, you must have an efficient instrument scan to minimize the time you are "inside" the cockpit. Knowing where and how your flight instruments are used is critical for basic instrument flying.

NOTES

LESSON GUIDE

COURSE/STAGE: T-45C TS & ADV Basic Instruments Flight Procedures

LESSON TITLE: Instrument Turns

LESSON IDENTIFIER: T-45C TS & ADV BIFP-03

LEARNING ENVIRONMENT: CAI

ALLOTTED LESSON TIME: 0.8 hr

STUDY RESOURCES:

- * NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
- * T-45C Instrument FTI

LESSON PREPARATION:

Read:

- * Paragraphs 17.3.1.1 through 17.3.2.4 in NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
- * T-45C Instrument FTI

REINFORCEMENT:

Review:

- * Turn Performance charts (34-5 through 35-11) in T-45C NATOPS Flight Manual, A1-T45AC-NFM-000

EXAMINATION:

The objectives in this lesson will be tested in TS and ADV BIFP-10X.

(8-99) ORIGINAL

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LESSON OBJECTIVES**2.7.1.1.2.2**

Recall procedures for controlling aircraft heading and turn rate

2.7.1.11.1

Recall procedures for performing turn pattern

2.7.1.12.1

Recall procedures for performing standard rate turns

2.7.1.2.1

Recall procedures for performing 1/2 standard rate turns

2.7.1.3.1

Recall procedures for performing partial panel timed turns

OVERVIEW

In this lesson, we will be studying the procedures, controls, and scans used in:

- * Normal turns
- * Turn patterns
- * Standard and 1/2 standard rate turns
- * Partial panel timed turns

REFRESHER

- * BIFP-02 reviewed flight instruments and scan techniques; in the following three lessons, we'll examine flight instruments and scan techniques in the context of instrument maneuvering.
- * Realize that T-45C scan techniques will differ from those you learned in T-34C due to differences in instrumentation, location, and aircraft performance.

PRESENTATION

I. Normal turns 2.7.1.1.2.2

A. Procedures

1. If heading change is less than 30 degrees, use AOB equal to the number of degrees of heading change
2. If heading change is 30 degrees or greater, use AOB of 30 degrees

B. Control

1. Adjust attitude as necessary
 - a. Roll-in: decreasing vertical component of lift may necessitate AOA increase
 - (1) Anticipate need for power with increased AOB
 - (2) Steeper bank requires additional power
 - b. Roll-out: increasing vertical component of lift may necessitate AOA decrease

C. Scan

1. Used to have to scan gauges at various positions in cockpit. Prior to use of multifunction displays (MFDs), scanning involved shifting attention between gauges located at different points on the instrument panel
2. Different flight phases require different cross-check patterns
3. Scanning is an acquired skill

4. Modern aircraft have consolidated instrument displays
5. Not all information is consolidated on the ADI display page. Nearly all required data for instrument flights are consolidated on the ADI display, but other instruments and indicators must still be checked for navigation, engine performance, etc.
6. Straight and level
 - a. ADI
 - b. Mach/airspeed
 - c. Altitude (or vertical velocity)
7. Transition (roll-in)
 - a. ADI
 - b. Altitude
8. Maintain turn
 - a. ADI
 - b. Mach/airspeed
 - c. Altitude
9. Transition (roll-out)
 - a. ADI
 - b. Altitude
10. Straight and level
 - a. ADI
 - b. Mach/airspeed

c. Altitude

11. ADI display contains

a. Pitch and bank

b. Heading

c. Turn indicator

d. Yaw indicator

e. TAS

f. Mach

g. Radar altitude

h. BARO altitude

i. BARO analog wiper

j. KIAS

k. KIAS analog wiper

l. Vertical velocity

m. AOA units

n. Instant g's

o. Peak g's

II. Turn pattern **2.7.1.11.1**

A. Procedure

1. Perform at a constant altitude

2. Perform at 250 KIAS

3. Pattern

- a. Make two 30-degree banked turns in opposite directions through 60 degrees of turn
- b. Make two 45-degree banked turns in opposite directions through 90 degrees of turn

4. Perform reversals through wings level, omitting straight-and-level legs

B. Control

1. Make smooth transitions with no pause at wings level
2. Adjust power as necessary to maintain airspeed

C. Scan

1. Transition

- a. ADI
- b. Altitude

2. Maintain turn

- a. ADI
- b. Mach/airspeed
- c. Altitude

III. Standard and 1/2 standard rate turns **2.7.1.12.1, 2.7.1.2.1**

A. Procedure

1. Standard rate

- a. Turn rate is 3 degrees per second
- b. Use 3-second lead to start maneuver

- c. Check that 10 seconds have elapsed with each 30 degrees of heading change

COMMON ERROR: Not using the 3-second lead point.

2. 1/2 standard rate

- a. Turn rate is 1.5 degrees per second
- b. Use 3-second lead to start maneuver
- c. Check that 20 seconds have elapsed with each 30 degrees of heading change

COMMON ERROR: Not using the 3-second lead point.

B. Control

- 1. Standard rate: use a bank angle equal to approximately 20 percent of KIAS
- 2. 1/2 standard rate: use a bank angle equal to approximately 10 percent of KIAS

C. Scan

- 1. Transition
 - a. ADI
 - b. Turn needle
 - c. Altitude
 - d. Clock
- 2. Maintain turn
 - a. ADI
 - b. Turn needle

c. Mach/airspeed

d. Altitude

IV. Partial panel timed turns **2.7.1.3.1**--used when aircraft heading system inoperative

A. Procedure

1. Determine number of degrees to be turned, using standby compass as starting reference point
2. Determine time required for turn by dividing number of degrees to be turned by turn rate (1-1/2 degrees or 3 degrees per second)

NOTE: A simpler method to determine timing for 1/2 standard rate turns for some students is to count the heading change in 30-degree increments, each of which equals 20 seconds, e.g., a 90-degree heading change requires 30, 60, 90 (three increments) at 20 seconds each, or 60 seconds.

NOTE: Do not use lead time in maneuver.

3. Start roll-in as second hand passes a cardinal point (3, 6, 9, or 12) on clock
4. Begin roll-out at end of predetermined time period (no lead point)
5. Check heading on magnetic compass after roll-out

B. Control

1. Establish bank angle that results in desired rate of turn (evidenced by needle deflection)
2. Maintain turn rate, altitude, and airspeed as required

C. Scan

NOTE: Presume both MFDs and HUD to be either inoperative or unreliable.

1. Transition

- a. Clock
- b. Standby compass
- c. Standby AI
- d. Standby altimeter
- e. Standby VSI
- f. Standby turn needle

2. Maintain turn

- a. Standby AI
- b. Standby airspeed
- c. Standby VSI
- d. Standby altimeter
- e. Clock

3. Transition

- a. Standby AI
- b. Standby altimeter
- c. Standby VSI

CONCLUSION

Because turns are among the most important of the basic flight maneuvers, to be a good instrument pilot you must be able to fly instrument turns with precision.

LESSON GUIDE

COURSE/STAGE: T-45C TS & ADV Basic Instruments Flight Procedures

LESSON TITLE: Basic Flight Maneuvers and Transitions

LESSON IDENTIFIER: T-45C TS & ADV BIFP-04

LEARNING ENVIRONMENT: CAI

ALLOTTED LESSON TIME: 0.8 hr

TRAINING AIDS: N/A

STUDY RESOURCES:

- * NATOPS Instrument Flight Manual, NAVAIR 00-80T-112

LESSON PREPARATION:

Read:

- * NATOPS Instrument Flight Manual, NAVAIR 00-80T-112: Instrument Groupings, and Climbs and Descents section.
- * FTI for Instrument Flight: Constant Airspeed Climbs and Descents, Constant Rate Climbs and Descents, Level Speed Changes, and Slow Flight sections.

REINFORCEMENT: N/A

EXAMINATION:

The objectives in this lesson will be tested in TS and ADV BIFP-10X.

(8-99) ORIGINAL

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LESSON OBJECTIVES**2.7.1.1.1.2**

Recall procedures for controlling aircraft altitude and rate of climb/descent

2.7.1.4.1

Recall procedures for performing level speed changes

2.7.1.10.1

Recall procedures for performing level speed change in 1/2 standard rate turns

2.7.1.8.1.1

Recall procedures for performing slow flight maneuver

OVERVIEW

In this lesson, you cover procedures and instructions:

- * Constant airspeed climbs and descents
- * Constant rate climbs and descents
- * Level speed changes
- * Slow flight maneuver

PRESENTATION

I. Constant airspeed climbs and descents **2.7.1.1.1.2**

A. Cruise to constant airspeed climb

1. Procedure

- a. Simultaneously, set power to MRT and pitch initially to 8-10 degrees noseup, then as required
- b. Maintain 250 kts
- c. Use a lead point of 10% of vertical velocity for level off
- d. Level off

2. Control

- a. Entry transition
 - (1) Advance power to MRT
 - (2) Simultaneously raise nose to 8-10 degrees noseup
- b. In maneuver: use pitch to control airspeed and trim to maintain a light feel on the stick

- c. Exit transition
 - (1) Use a lead point of 10% of vertical velocity
 - (2) Maintain airspeed, monitor altitude readout and vertical velocity for altitude change
 - (3) Reduce power to cruise setting, adjust pitch for level flight, retrim
- 3. Scan
 - a. Entry transition
 - (1) Pitch
 - (2) RPM/fuel flow indicator
 - b. In maneuver
 - (1) Pitch
 - (2) Airspeed
 - (3) Altitude
 - (4) Vertical velocity
 - c. Exit transition
 - (1) Pitch
 - (2) Altitude
 - (3) Vertical velocity
 - (4) RPM/fuel flow indicator

B. Cruise to constant airspeed descent

1. Procedure

- a. Set power to idle
- b. Set pitch to 3-6 degrees nosedown
- c. Maintain 250 KIAS
- d. Use a lead point of 10% of vertical velocity for level-off

2. Control

- a. Entry transition
 - (1) Reduce power to idle
 - (2) Simultaneously lower nose to 3-6 degrees nosedown
- b. In maneuver: use pitch to control airspeed
- c. Exit transition
 - (1) Use a lead point of 10% of vertical velocity
 - (2) Raise power to cruise setting
 - (3) Establish pitch reference for level flight and trim

3. Scan

- a. Entry transition
 - (1) Pitch
 - (2) RPM/fuel flow indicator
- b. In maneuver
 - (1) Pitch

(2) Altitude

(3) Vertical velocity

c. Exit transition

(1) Pitch

(2) Altitude

(3) Vertical velocity

(4) RPM/fuel flow indicator

II. Constant rate climbs and descents

A. Constant rate climb

1. Procedure

- a. Set power to 1,500 pph
- b. Adjust nose to about 2-3 degrees noseup to maintain 200 KIAS
- c. Adjust power to maintain 1,000 fpm climb
- d. Lead level-off at target altitude minus 10% of vertical velocity

2. Control

- a. Entry transition: establish 1,000 fpm rate of climb by simultaneously advancing power and raising nose
- b. In maneuver
 - (1) Control airspeed with adjustments to pitch

NOTE: Pitot static instruments contain lag factors. Don't chase the vertical velocity with pitch or power adjustments.

- (2) Control rate of climb with adjustments to power
- c. Exit transition
 - (1) Use a lead point of 10% of vertical speed
 - (2) Reduce power to slow cruise setting
 - (3) Establish a pitch reference for level flight
- 3. Scan
 - a. Transition to climb
 - (1) Pitch
 - (2) Airspeed
 - (3) RPM/fuel flow indicator
 - b. Maintain climb
 - (1) Pitch
 - (2) Airspeed
 - (3) Vertical velocity
 - (4) RPM/fuel flow indicator
 - c. Pre-transition for level-off
 - (1) Altitude
 - d. Level-off
 - (1) Pitch
 - (2) Airspeed
 - (3) RPM/fuel flow indicator

B. Constant rate descent

1. Procedure

- a. Set power to 700 pph
- b. Adjust nose to approximately 1-2 degrees nose down to maintain 200 KIAS
- c. Adjust power to maintain 1,000 fpm descent
- d. Lead level off at target altitude plus 10% of vertical velocity (100 ft)

2. Control

- a. Entry transition: establish 1,000 fpm rate of descent by simultaneously reducing power to 700 pph and lowering nose about 2 degrees
- b. In maneuver
 - (1) Control airspeed with adjustments to pitch
 - (2) Control rate of descent with adjustments to power
- c. Exit transition
 - (1) Use a lead point of 10% of vertical speed
 - (2) Advance power to slow cruise setting
 - (3) Establish a pitch reference for level flight

3. Scan

- a. Transition to descent
 - (1) Pitch
 - (2) Airspeed
 - (3) RPM/fuel flow

b. Maintaining descent

- (1) Pitch
- (2) RPM/fuel flow
- (3) Vertical velocity
- (4) Airspeed

c. Pre-transition for level off

- (1) Altitude

d. Level-off

- (1) Pitch
- (2) Airspeed
- (3) RPM/fuel flow indicator

III. Level speed changes

A. Wings level (speed increase) **2.7.1.4.1**

1. Procedure

- a. Advance power beyond the setting for desired airspeed or to MRT for changes greater than 20 kts
- b. Decrease nose attitude as required to maintain level flight
- c. Maintain a constant heading

2. Control

- a. Entry transition
 - (1) Advance power
 - (2) Correct for initial pitchup from increase in thrust

- b. In maneuver
 - (1) Correct pitch as lift increases
 - (2) Adjust trim to maintain neutral stick pressure throughout maneuver
 - c. Exit transition
 - (1) At lead point of 5 kts, reduce power to the setting for new airspeed
 - (2) Establish a new pitch reference for level flight
3. Scan
- a. Transition into an airspeed change
 - (1) Attitude
 - (2) RPM/fuel flow
 - (3) Altitude
 - (4) Vertical velocity
 - (5) Airspeed
 - b. In maneuver
 - (1) Attitude
 - (2) Airspeed indicator
 - (3) Altitude
 - (4) Vertical velocity
 - c. Transition out of airspeed change
 - (1) Attitude
 - (2) RPM/fuel flow indicator

(3) Altitude

(4) Vertical velocity

(5) Airspeed

B. Wings level (speed decrease) 2.7.1.4.1

1. Small change in airspeed

a. Procedure

(1) Decrease power to less than the required setting for desired airspeed

(2) Increase nose attitude as required to maintain level flight

(3) Maintain a constant heading

(4) 5 kts prior to target airspeed, advance power to setting for new airspeed

(5) Adjust power as required to maintain desired airspeed

b. Control

(1) Entry transition

(a) Decrease power

(b) Correct for initial pitchdown from decrease in thrust

(2) In maneuver

(a) Correct pitch as lift decreases

(b) Adjust trim to maintain neutral pressure throughout the maneuver

(3) Exit transition

- (a) At 5 kts prior to target airspeed, advance power to the setting for new airspeed
- (b) Establish a new pitch reference for level flight and trim

c. Scan

(1) Transition into airspeed change

- (a) Attitude
- (b) RPM/fuel flow indicator
- (c) Altitude
- (d) Vertical velocity

(2) In maneuver

- (a) Attitude
- (b) Altitude
- (c) Vertical velocity
- (d) Airspeed

(3) Transition out of airspeed change

- (a) Attitude
- (b) RPM/fuel flow indicator
- (c) Altitude
- (d) Vertical velocity
- (e) Airspeed

2. Large or rapid change in airspeed

a. Procedure

- (1) Decrease power to the setting for desired airspeed and extend speed brakes

NOTE: You should anticipate a pitchup with speed brake extension.

- (2) Increase nose attitude as required to maintain level flight
- (3) Maintain a constant heading
- (4) Retract speed brakes 5 kts prior to desired airspeed
- (5) Adjust power to maintain desired airspeed

b. Control

(1) Entry transition

- (a) Decrease power
- (b) Extend speed brakes

(2) In maneuver

- (a) Correct pitch as lift decreases
- (b) Adjust trim to maintain neutral pressure throughout the maneuver

(3) Exit transition

- (a) 5 kts prior to desired airspeed, retract speed brakes
- (b) Establish a new pitch reference for level flight and trim

c. Scan

(1) Transition into airspeed change

- (a) Attitude
- (b) RPM/fuel flow indicator
- (c) Altitude
- (d) Vertical velocity

(2) In maneuver

- (a) Attitude
- (b) Altitude
- (c) Vertical velocity
- (d) Airspeed

(3) Transition out of airspeed change

- (a) Attitude
- (b) RPM/fuel flow indicator
- (c) Altitude
- (d) Vertical velocity
- (e) Airspeed

C. 1/2 SRT (increase airspeed) **2.7.1.10.1**

1. Procedure

- a. Advance power to above that required for new airspeed

NOTE: Use MRT for speed changes of 20 kts or greater.

- b. Establish 1/2 SRT
- c. Maintain altitude and constant rate of turn
- d. Check heading every 20 seconds for 30 degrees of change
- e. Reduce power at 5-kt lead point to new airspeed heading
- f. Continue constant rate turn to new heading and roll out at a lead of 1/3 AOB

2. Control

- a. Entry transition
 - (1) Increase power to required setting
 - (2) Establish angle of bank
- b. In maneuver
 - (1) Adjust pitch to maintain altitude
 - (2) Increase AOB to maintain 1/2 SRT as aircraft accelerates
 - (3) Verify turn rate on turn-slip indicator
 - (4) Trim out stick forces
 - (5) Make AOB correction if you are ahead or behind turn schedule
- c. Exit transition
 - (1) At lead point of 5 KIAS, decrease power to the setting for new airspeed
 - (2) At lead point of 1/3 of AOB, roll out of turn
 - (3) Establish new pitch reference for level flight

3. Scan

a. Transition into the turn

- (1) Attitude
- (2) Turn-slip
- (3) Altitude
- (4) Vertical velocity
- (5) RPM/fuel flow indicator

b. Maintaining the turn

- (1) Attitude
- (2) Turn-slip
- (3) Altitude
- (4) Vertical velocity
- (5) Clock
- (6) Airspeed

c. Transition out of airspeed change

- (1) Attitude
- (2) Turn-slip
- (3) Altitude
- (4) Vertical velocity
- (5) Airspeed
- (6) RPM/fuel flow indicator

d. Roll-out

(1) Attitude

(2) Heading

(3) Altitude

(4) Vertical velocity

(5) Airspeed

(6) RPM/fuel flow indicator

D. 1/2 SRT (decrease airspeed) **2.7.1.10.1**

1. Procedure

a. Initiate a 1/2 SRT, 10% of IAS

b. Decrease power to setting for desired airspeed

c. Extend speed brakes

d. Check heading every 20 seconds for 30 degrees of change

e. Decrease AOB as airspeed decreases to maintain 1/2 SRT

f. Retract speed brakes at lead point of 5 kts (Trim as required to maintain level flight)

g. Continue to new heading and lead roll-out by 1/3 AOB

2. Control

a. Entry transition

(1) Decrease power to required setting

(2) Establish angle of bank

(3) Extend speed brakes

b. In maneuver

- (1) Check turn rate using ADI and clock
- (2) Verify turn rate on turn needle
- (3) Trim to maintain neutral stick pressure throughout the maneuver

c. Exit transition

- (1) At lead point of 5 kts, retract speed brakes and adjust power as necessary
- (2) At lead point of 1/3 of AOB, roll out of turn and adjust pitch
- (3) Establish new pitch reference for level flight and trim

3. Scan

a. Transition into the turn

- (1) Attitude
- (2) Turn-slip
- (3) Altitude
- (4) Vertical velocity
- (5) RPM/fuel flow indicator

b. Maintaining the airspeed change

- (1) Attitude
- (2) Turn-slip
- (3) Altitude
- (4) Vertical velocity

(5) Clock

(6) Airspeed

c. Transition out of airspeed change

(1) Attitude

(2) Turn-slip

(3) Altitude

(4) Vertical velocity

(5) Airspeed

(6) RPM/fuel flow indicator

d. Roll-out

(1) Attitude

(2) Heading

(3) Altitude

(4) Vertical velocity

(5) Airspeed

(6) RPM/fuel flow indicator

IV. Slow flight maneuver **2.7.1.8.1.1**

A. Procedure

1. Level flight
2. Level speed change
3. Perform a 30-degree AOB turn for 90 degrees of heading change (maintain 200 KIAS)
4. Landing configuration

5. 20-degree AOB turn (45 degrees)
6. 20-degree AOB turn (45 degrees)
7. Final approach speed
8. 10-degree AOB turn (30 degrees)
9. 10-degree AOB turn (30 degrees)
10. On-speed descent
11. On-speed level flight
12. Missed approach
13. Slow cruise
14. Level speed change
15. Level flight

B. Control

1. Level speed change
 - a. Entry
 - (1) Decrease power and extend speed brakes;
adjust pitch after speed brake extension
 - (2) Increase nose attitude as required to maintain
level flight
 - (3) Maintain a constant heading
 - b. In maneuver: correct pitch for level flight as
airspeed decreases
 - c. Exit
 - (1) At lead point of 5 kts, retract speed brakes and
adjust power to maintain 200 KIAS

- (2) Establish new pitch reference for level flight
- 2. 90-degree turn, 30 degrees AOB
 - a. Entry
 - (1) Establish 30 degrees angle of bank
 - (2) Adjust attitude as required to maintain level flight and trim as required
 - (3) Adjust power to maintain airspeed
 - b. In maneuver
 - (1) Maintain 30 degrees angle of bank
 - (2) Adjust attitude to maintain level flight and trim as required
 - (3) Adjust power as required to maintain airspeed
 - c. Exit
 - (1) Use 1/3 of bank angle as lead point for roll-out
 - (2) Adjust pitch and power during roll-out to maintain level flight and airspeed and trim as required
- 3. Landing approach configuration
 - a. Entry
 - (1) Decrease power
 - (2) Lower gear
 - (3) Set full flaps/slats
 - b. In maneuver
 - (1) Adjust pitch to maintain level flight
 - (2) Adjust pitch as flaps/slats are extended

- (3) Trim
- c. Exit
 - (1) At lead point of 5 kts, advance power to maintain 150 KIAS
 - (2) Establish a new pitch reference for level flight and retrim
 - (3) Complete landing checklist
- 4. 45-degree turns, 20 degrees AOB
 - a. Entry
 - (1) Establish 20 degrees angle of bank
 - (2) Adjust nose attitude to maintain level flight and trim as required
 - (3) Adjust power as required to maintain airspeed
 - b. In maneuver
 - (1) Maintain 20 degrees angle of bank
 - (2) Adjust attitude to maintain level flight and trim as required
 - (3) Adjust power as required to maintain airspeed
 - c. Exit
 - (1) Use 1/3 of bank angle as lead point for roll-out
 - (2) Adjust pitch and power during roll-out to maintain level flight and airspeed and trim as required
- 5. Level speed change to approach speed
 - a. Entry
 - (1) Decrease power to 700 pph

- (2) Increase nose attitude as required to maintain level flight and trim
 - (3) Maintain a constant heading
 - b. In maneuver: correct pitch for level flight as airspeed decreases
 - c. Exit: adjust nose attitude and power to maintain level flight at optimum AOA
6. 30-degree turns, 10 degrees AOB
- a. Entry
 - (1) Establish 10 degrees angle of bank
 - (2) Adjust attitude to maintain level flight
 - (3) Adjust power as required to maintain optimum AOA
 - b. In maneuver
 - (1) Maintain 10 degrees angle of bank
 - (2) Adjust attitude to maintain level flight and trim as required
 - (3) Adjust power as required to maintain optimum AOA
 - c. Exit
 - (1) Use 1/3 of bank angle as lead point for roll-out
 - (2) Adjust pitch and power during roll-out to maintain level flight and AOA
7. On-speed descent
- a. Entry

- (1) Extend speed brakes
 - (2) Establish a 500 fpm descent
 - (3) Adjust pitch to maintain optimum AOA
- b. In maneuver
 - (1) Control rate of descent with power
 - (2) Control AOA with pitch
- c. Exit
 - (1) Use 10% of vertical velocity as the lead point for level off
 - (2) Adjust power to arrest rate of descent
 - (3) After level off, readjust power to level flight
- 8. On-speed level flight
- 9. Missed approach
 - a. Entry
 - (1) Add power to MRT and retract speed brakes
 - (2) Maintain optimum AOA until intercepting 10 degrees noseup
 - (3) Confirm climb on vertical velocity and altitude readout
 - (4) Raise gear
 - (5) At 140 KIAS, raise flaps/slats
 - b. In maneuver
 - (1) At 200 KIAS, raise nose to maintain airspeed

(2) Trim as necessary to maintain neutral pressure on stick

c. Exit

(1) Use 10% of the vertical rate as the lead point for level off

(2) Set power to slow cruise

(3) Adjust pitch for level flight at 200 KIAS and original altitude

10. Slow cruise: adjust pitch and power to maintain level flight at 200 KIAS

11. Level speed change

a. Entry

(1) Advance power to MRT

b. In maneuver

(1) Correct pitch as airspeed increases

c. Exit

(1) At lead point of 5 kts, reduce power to cruise setting

(2) Establish a new pitch reference for level flight and trim

12. Level flight: stabilize airspeed at 250 KIAS

C. Scan: the slow flight maneuver is designed to use all of the individual maneuver scans that you have learned to this point.

The key to a good slow flight maneuver scan is recognizing that this maneuver is only a sequence of basic flight maneuvers and therefore basic flight maneuver scans.

CONCLUSION

Basic flight maneuvers and transitions are simply combinations of the BI flight building blocks.

You have learned about the procedures, control and scan for these maneuvers and are ready to progress to more advanced maneuvers.

NOTES

LESSON GUIDE

COURSE/STAGE: T-45C TS & ADV Basic Instruments Flight Procedures

LESSON TITLE: “S” Patterns

LESSON IDENTIFIER: T-45C TS & ADV BIFP-05

LEARNING ENVIRONMENT: CAI

ALLOTTED LESSON TIME: 0.8 hr

TRAINING AIDS:

- * Figures
- Fig 1: S-1 Pattern
- Fig 2: S-3 Pattern

STUDY RESOURCES: T-45C Instrument FTI

LESSON PREPARATION:

Read:

- * Sections on “S” patterns in the FTI

REINFORCEMENT: N/A

EXAMINATION:

The objectives in this lesson will be tested in TS & ADV BIFP-10X.

(8-99) ORIGINAL

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LESSON OBJECTIVES**2.7.1.5.1**

Recall procedures for performing the S-1 pattern

2.7.1.7.1

Recall procedures for performing the S-3 pattern

MOTIVATION

The confidence you gain from mastering basic instrument maneuvers will help you meet the challenges of instrument flight—from enroute navigation to a complex instrument approach in turbulent weather.

In this lesson, we’ll discuss “S” patterns. Each maneuver will be broken down into its component parts. You may find it easier to perform a complex maneuver if you remember that it is composed of several simpler maneuvers. Concentrate on each submaneuver as you fly it and the whole maneuver will seem simpler.

We will look at how “S” patterns are performed under instrument conditions.

Procedures used in the “S” patterns may be used during instrument approaches and missed approaches.

OVERVIEW

After this lesson, you will know the procedures, controls, and scans for performing “S” patterns. You will know how to interpret instrument indications and respond to them appropriately.

This lesson consists of the procedures, controls, and scans for:

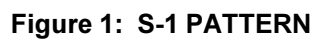
- * S-1 pattern
- * S-3 pattern

PRESENTATION**I. S-1 pattern 2.7.1.5.1****Fig 1: S-1 Pattern****A. Procedure**

1. Start maneuver using a three-second lead prior to the 12 o'clock position
2. Descend for 1,000 ft at 1,000 fpm
3. Start transition to climb/descent three seconds prior to end of climb/descent or 100 ft prior to the end of the 1,000 ft climb/descent (whichever occurs first)
4. Climb for 1,000 ft at 1000 fpm
5. Perform pattern at constant airspeed of 200 KIAS
6. Pattern is complete at the end of the second climb
7. After pattern, transition to level flight, stabilizing aircraft at original cruise airspeed and altitude

B. Control

1. Entry into maneuver
 - a. Ensure a three-second lead point (prior to the 12 o'clock position)
 - b. Establish pitch attitude of 1-2 degrees nosedown
 - c. Establish power setting of 700 pph



2. Climb and descent

a. Airspeed

(1) Maintain at 200 KIAS

(2) Ensure proper pitch

(a) 1-2 degrees nosedown for descent

(b) 2-3 degrees noseup for climb

COMMON ERROR: Adjusting power instead of pitch to control airspeed.

b. Rate

(1) Monitor proper power setting

(a) 1,500 pph for climb

(b) 700 pph for descent

(2) Maintain 250-ft altitude change every 15 seconds (1,000 fpm)

COMMON ERROR: Adjusting pitch instead of power to control rate of climbs and descents.

COMMON ERROR: Adjusting pitch or power and not the other. Because they affect one another, a correction to one will probably require a corresponding correction to the other.

3. Transition to climb/descent

a. Approximate the lead point

(1) Three seconds prior to elapsed minute

(2) 100 ft from altitude

- b. Establish correct power setting

- (1) Approximately 1,500 pph for climb

- (2) Approximately 700 pph for descent

- c. Execute a smooth progression to correct pitch attitude

COMMON ERROR: Making corrections too soon due to inaccurate VSI and altimeter indications (instrument lag).

- 4. Level off at entry altitude

- a. Adjust power to original cruise setting of 1,100 pph

- b. Maintain airspeed of 200 KIAS

- c. Check for original altitude

- C. Scan

- 1. Straight and level

- a. Attitude: ADI

- b. Power: Fuel flow indicator

- c. Performance

- (1) Airspeed

- (2) Altitude

- (3) Vertical velocity

- (4) Heading

- 2. Transition into descent

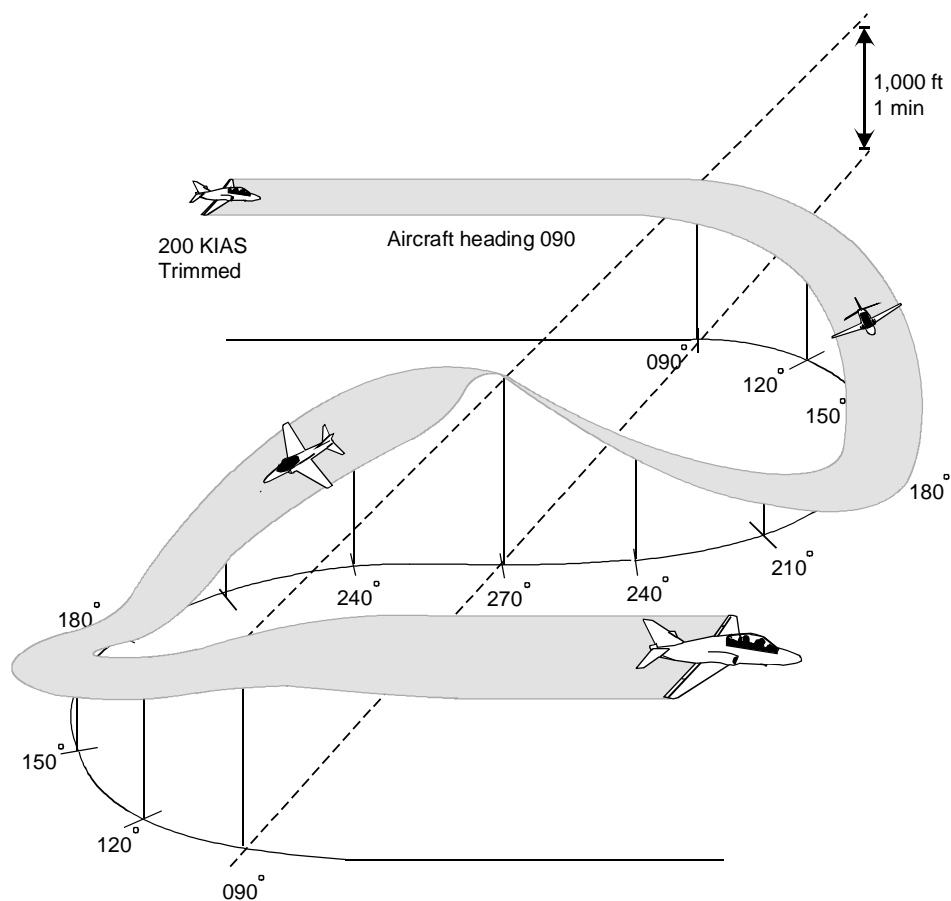
- a. Attitude: ADI

- b. Power: Fuel flow indicator

- c. Performance
 - (1) Clock
 - (2) Altitude
 - (3) Vertical velocity
 - (4) Airspeed
 - (5) Heading
- 3. Maintaining descent
 - a. Attitude: ADI
 - b. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Clock
- 4. Pre-transition
 - a. Attitude: ADI
 - b. Power: Fuel flow indicator
 - c. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Clock

5. Transition to climb
 - a. Attitude: ADI
 - b. Power: Fuel flow indicator
 - c. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Clock
6. Maintaining climb
 - a. Attitude: ADI
 - b. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Clock
7. Pre-transition for level off
 - a. Attitude: ADI
 - b. Power: Fuel flow indicator

Fig 2: *S-3 Pattern*

**Figure 2: S-3 PATTERN**

c. Performance

(1) Altitude

(2) Vertical velocity

(3) Airspeed

(4) Heading

(5) Clock

8. Level off

a. Attitude: ADI

b. Power: Fuel flow indicator

c. Performance

(1) Airspeed

(2) Altitude

(3) Vertical velocity

(4) Heading

II. S-3 pattern **2.7.1.7.1**

A. Procedure

1. Incorporates the S-1 pattern

a. Start maneuver using a three-second lead prior to 12 o'clock position

b. Descend for 1,000 ft at 1,000 fpm and then climb for 1,000 ft at 1,000 fpm

c. Start transition from descent to climb three seconds prior to descent (climb) or 100 ft prior to the end of the 1,000 ft descent (climb) (whichever occurs first)

- d. Perform pattern at constant airspeed of 200 KIAS
 2. Begin constant 1/2 SRT simultaneously with beginning of first descent
 3. Reverse direction of turn at beginning of every descent
 4. Pattern is complete at end of second climb
- B. Control
1. Entry into maneuver
 - a. Ensure a three-second lead point (prior to 12 o'clock position)
 - b. Establish power setting of 700 pph
 - c. Establish pitch attitude at 1-2 degrees nosedown
 2. Climb and descent
 - a. Airspeed
 - (1) Maintain at 200 KIAS
 - (2) Ensure proper pitch
 - (a) 2-3 degrees noseup for climb
 - (b) 1-2 degrees nosedown for descent

COMMON ERROR: Adjusting power instead of pitch to control airspeed.
 - b. Rate
 - (1) Monitor proper power setting
 - (a) 1,500 pph for climb
 - (b) 700 pph for descent

- (2) Maintain 250 ft altitude change every 15 seconds (1,000 fpm)

COMMON ERROR: Adjusting pitch instead of power to control rate.

COMMON ERROR: Adjusting pitch or power and not the other. Because they affect one another, a correction to one will probably require a corresponding correction to the other.

3. Transition to climb/descent

a. Approximate the lead point

- (1) Three seconds prior to elapsed minute

- (2) 100 ft from altitude

b. Establish correct power setting

- (1) 1,500 for climb

- (2) 700 for descent

c. Execute a smooth progression to correct pitch attitude

COMMON ERROR: Making corrections too soon due to lagging instrument indications.

4. Level off at entry altitude

a. Check for original altitude

b. Ensure zero degrees pitch

c. Return to airspeed of 200 KIAS

d. Cross-check for original cruise power

5. Turns

- a. Establish bank angle that gives a 1 needle width deflection
- b. Adjust attitude to ensure desired airspeed of 200 KIAS
- c. Adjust power as necessary to ensure 1,000 fpm rate of climb/descent
- d. Heading change should be 30 degrees every 20 seconds

C. Scan

1. Straight and level

- a. Attitude: ADI
- b. Performance
 - (1) Airspeed
 - (2) Altitude
 - (3) Vertical velocity
 - (4) Heading

2. Transition into descending turn

- a. Attitude: ADI
- b. Power: Fuel flow indicator
- c. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading

- (5) Turn needle
- (6) Clock
- 3. Maintaining descending turn
 - a. Attitude: ADI
 - b. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Turn needle
 - (6) Clock
- 4. Pre-transition
 - a. Attitude: ADI
 - b. Power: Fuel flow indicator
 - c. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Turn needle
 - (6) Clock

5. Transition to climbing turn

- a. Attitude: ADI
- b. Power: Fuel flow indicator
- c. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Turn needle
 - (6) Clock

6. Maintaining climbing turn

- a. Attitude: ADI
- b. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Turn needle
 - (6) Clock

7. Pre-transition for level-off

- a. Attitude: ADI
- b. Power: fuel flow indicator
- c. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading
 - (5) Turn needle
 - (6) Clock

8. Level off

- a. Attitude: ADI
- b. Power: Fuel flow indicator
- c. Performance
 - (1) Altitude
 - (2) Vertical velocity
 - (3) Airspeed
 - (4) Heading

SUMMARY

This lesson covered the procedure, control, and scan techniques for:

- * S-1 pattern
- * S-3 pattern

CONCLUSION

As a Naval aviator, you play a major part in our nation's security. To perform your duties in an outstanding manner will require you to spend a great deal of time practicing flight maneuvers. The confidence that you gain from practice will let you focus on more pressing matters in an actual mission—like dropping your bombs on target.

NOTES

WORKBOOK LESSON

COURSE/STAGE: T-45C TS & ADV Basic Instruments Flight Procedures

LESSON TITLE: Instrument Failures

LESSON IDENTIFIER: T-45C TS & ADV BIFP-09

TRAINING AIDS:

- * Figures
 - Fig 1: Failed AI
 - Fig 2: Failed AOA

STUDY RESOURCES:

- * NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
- * T-45C NATOPS Flight Manual, A1-T45AC-NFM-000

LESSON PREPARATION:

Read:

- * Paragraphs 17.6.1 and 17.6.2 in the NATOPS Instrument Flight Manual, NAVAIR 00-80T-112

REINFORCEMENT:

Review:

- * Your Eng-21 Lesson Guide, "Flight Instrument Malfunctions"

EXAMINATION:

The objectives in this lesson will be tested in TS BIFP-10X and ADV BIFP-07X.

(8-99) ORIGINAL

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LESSON OBJECTIVES**2.8.1.1.1**

Recall procedure for GINA failure

1.8.1.7.12.2

Recall procedure for HSI failure

1.8.1.7.1.2

Recall procedure for ADI failure

1.8.1.7.10.2

Recall procedure for turn and slip indicator failure

1.8.1.7.3.2

Recall procedure for pitot static malfunctions

1.8.1.7.2.2

Recall procedure for airspeed indicator failure

1.8.1.7.9.2

Recall procedure for altimeter failure

1.8.1.7.8.2

Recall procedure for VSI failure

1.8.1.7.6.2

Recall procedure for standby attitude indicator (AI) failure

1.8.1.7.4.2

Recall procedure for AOA indicator failure

1.8.1.7.11.2

Recall procedure for radar altimeter failure

1.8.1.9.8.2

Recall procedure for VOR failure

1.8.1.9.4.2

Recall procedure for TACAN bearing failure

1.8.1.9.9.2

Recall procedure for ILS glideslope failure

1.8.1.9.10.2

Recall procedure for ILS localizer failure

1.8.1.9.11.2

Recall procedure for ILS marker beacon failure

2.7.4.1.1

Recall procedures for flight with partial panel

HOW TO USE THIS WORKBOOK

1. This is a workbook/lab that you will complete in group session with an instructor. FLIP publications, charts, and the T45C NATOPS will be available.
2. Lesson information is accompanied by exercises and/or questions to measure your understanding of the subject matter. Answers are provided in the back of the workbook to allow you to monitor your progress through the lesson.

MOTIVATION

Aircraft instrument systems are subjected to an exceptionally harsh environment of g loading and extremes of temperature, pressure, and humidity. It is a tribute to the efforts of manufacturers and maintenance personnel that we so rarely experience an instrument failure in flight. Although rare, instrument failures do happen, so it is crucial that you be prepared to handle one safely.

OVERVIEW

When you have completed this lesson, you should be able to recall the step-by-step procedures for dealing with instrument failures in flight.

This lesson consists of the procedures for:

- * MFD display failure
- * HSI failure
- * ADI failure
- * Turn and slip indicator failure
- * Pitot static malfunctions
- * Standby airspeed indicator failure
- * Standby barometric altimeter failure
- * Standby VSI failure
- * Standby AI failure
- * AOA indicator failure
- * Radar altimeter failure
- * VOR failure
- * TACAN bearing/DME failure
- * ILS glideslope failure
- * ILS localizer failure
- * ILS marker beacon failure
- * Partial panel flight

REFRESHER

- * Recall instrument failure procedures from your T-34C instrument training.
- * Realize that T-45C scan patterns and techniques differ significantly from those you learned in T-34C due to differences in instrument displays, location, and aircraft performance.

PRESENTATION

The following procedures assume a single aircraft with functioning radios and transponder. If you are able to summon a wingman or make a lead change, you can greatly reduce the problems encountered with an instrument failure. If you lose any primary navigation or pitot static instruments on an IFR flight, you are required to notify ATC.

With each of these failures you should cross-check any suspect instrument indication with the other cockpit if you are flying dual.

The T-45C display system consolidates traditional analog control, performance, and navigation instruments into a digital multifunctional electronic array. This system is not prone to electrical or mechanical malfunction.

In aircraft with exclusive analog instrumentation, pilots must be prepared to manage multiple instrument failures, including flight director ADI and HSI components. The T-45C cockpit is equipped with fundamental analog instruments; however, those data outputs are duplicated within the digital display system. The analog instruments are available as backups, should digital data sources become erroneous, unreliable, or lost. Fortunately, the digital system is very reliable.

This workbook examines six categories of possible problems that may occur, which involve aspects of the T-45C digital display system:

- Single MFD failure
- Right or left (both cockpits) MFD failure
- Total (all four) MFD failure
- Blank, missing, incorrect MFD data
- MFD push-button failure
- Data source failure

It also discusses failure of the following individual instruments:

- Standby AI
- Radar altimeter
- Standby barometric altimeter
- Standby VSI
- AOA
- Turn/slip
- Standby airspeed indicator

And, it addresses failure of the following navigation equipment:

- VOR
- TACAN
- ILS glideslope
- ILS localizer
- Marker beacon

Finally, partial panel instrument flight is discussed.

MFD DISPLAY FAILURE 2.8.1.1.1

When a T-45C pilot first sees or suspects an MFD display problem, he should coordinate with the other pilot to determine if both cockpit display systems are involved. Next, the problem MFD(s) should be recycled to OFF and then back to N or D, as appropriate.

Single MFD Failure: If just a single MFD display unit appears inoperative and the screen is blank, the pilot should turn the MFD CONT and BRT knobs full clockwise. If, then, a raster scan is visible, it can be concluded that the unit is electronically functional. If no raster scan becomes visible, cycle the DISPLAY POWER switch to RESET, which will recycle power to the DEU. If after recycling, a raster scan is still not visible, conclude that the MFD display unit is probably nonrecoverable. The problem is with an internal MFD component, with wiring, or elsewhere in the display system. With just one good MFD, the pilot will have to individually select single page displays that are most appropriate to the concern of the moment: stores management, system analysis, cruise, approach, recovery, etc.

Right or Left (both cockpits) MFD Failure: When right or left MFDs in both cockpits appear to have failed, it is likely that a left or right raster graphic generator is the cause. The displays may exhibit a complete or partial data loss, or the freezing of data displays. To possibly correct the problem, cycle the DISPLAY POWER switch to RESET. If that does not correct the problem, conclude that both display units are nonrecoverable.

Total (all four) MFD Failure: Total failure of all four MFDs is unlikely. Such an unusual circumstance would most likely relate to a malfunction within the DEU. About all a pilot can do is cycle the DISPLAY POWER switch to RESET, recycling power to the DEU. If that fails to correct the problem, the MFDs are probably nonrecoverable. Aircraft recovery will have to be accomplished using standby instruments. Navigation sources will not be available, so assistance should be sought from ATC and/or other aircraft, as appropriate. Consider declaring an in-flight emergency.

Blank, Missing, Incorrect MFD data: Missing data on an MFD might be the result of a variety of problems. Whether or not an AV BIT legend appears in the lower right-hand corner of the MFD(s), select the BIT page option and check for GO, OPGO, and DEGD alerts. Reset or recycle equipment, as may be appropriate. If the MFD system was missing attitude and/or position information, the problem may be related to a GINA failure; then, expect the GINA BIT to indicate DEGD. TACAN, airspeed, and altimeter information will still be displayed, concurrently with a GINA failure.

MFD Push-Button Failure: An apparent MFD problem may be caused by a malfunctioning MFD push-button. If that happens while on the ground, initiate DSPY MBIT (manual BIT) checking of the MFD push-buttons; DEP push-buttons can also be checked. When in-flight, DSPY MBIT is disabled. Push-button functionality can only be assessed by manipulating the individual push-buttons.

Data Source Failure: Some systems—such as TACAN, VOR, and ILS—are not automatically BIT monitored and reported on the BIT status display page. If data from an unmonitored source appears missing or incorrect, first, check the status of that equipment. Be certain that it is properly turned ON and that it is properly set for desired operation. Then, if the equipment incorporates a stand-alone BIT feature, activate that BIT to check functionality.

HSI FAILURE 1.8.1.7.12.2

A digital display system does not manifest a failed HSI in the same context as a flight director or older analog system. The HSI display page can be called up in a variety of formats and on multiple MFD units.

The HSI display page presents a lot of data; some graphically and some alphanumerically. Different MFD/DEU system problems will result in different visible circumstances. For example, loss of the GINA will cause a loss of aircraft attitude and INS-based position information, but TACAN, airspeed, and altitude will remain. Additionally, a stuck MFD push-button may disable a particular HSI function on that particular MFD unit. Switching the display to another unit may resolve the difficulty.

As you know, there are no warning or OFF flags on the HSI display, other than AV BIT. If a data or graphical image problem is suspected, four logical investigative steps should be followed:

- Be sure associated equipment that supplies the data in question is ON.
- Be sure data has been properly entered: e.g., waypoint data, frequencies.
- Perform BIT checks on suspect equipment: e.g., TACAN, VOR/ILS.
- Check the DATA display page for any OPGO/DEGD alerts and react accordingly.

Normally, the HSI will be selected for display on the right MFD. To assure that an HSI problem is not really an MFD problem, call up the same HSI display on another MFD unit and compare results.

The procedure for dealing with an HSI failure is:

1. Determine the nature of the malfunction.
2. Use backup navigation instruments as appropriate.
3. Report essential HSI failure to ATC.
4. Maintain VFR conditions, if possible
5. Land as soon as practicable.

ADI FAILURE 1.8.1.7.1.2

A digital display system does not manifest a failed ADI in the same context as a flight director or older analog system. The ADI display page can be called up on multiple MFD units in the two cockpits.

The ADI display page presents not only aircraft attitude data, but also heading, BARO altitude, radar altitude, KIAS, TAS, AOA, Mach, g-loadings, vertical velocity, and turn/slip information. Additionally, LAW and BINGO parameters can be set using this display page and associated increment/decrement push-buttons.

Loss of the GINA will cause a loss of the aircraft attitude portion of the ADI display. Loss of other instruments (e.g., radar altimeter) will result in the loss of associated readouts on the ADI. Additionally, a stuck MFD push-button may just disable a particular ADI function on that particular MFD unit. Switching the desired display to another unit may resolve the difficulty.

As you know, there are no warning or OFF flags on the ADI display, other than AV BIT. If a data or graphical image problem is suspected, four logical investigative steps should be followed:

- Be sure associated equipment that supplies the data in question is ON.
- Be sure data has been properly entered: e.g., the proper ILS frequency is needed for ILS steering, CDI mode is needed for both VOR and ILS.
- Perform BIT checks on suspect equipment: e.g., radar altimeter, VOR/ILS.
- Check the DATA display page for any OPGO/DEGD alerts and react accordingly.

Normally, the ADI will be selected for display on the left MFD. To assure that an ADI problem is not really an MFD problem, call up the ADI display on another MFD unit and compare results.

The procedure for dealing with an ADI failure is:

1. Use the standby attitude indicator (AI) for attitude reference.
2. If available, use the HSI for your primary heading reference; if not, use the standby compass.
3. Maintain VFR and VMC conditions, if possible.
4. Report essential ADI instrument failure to ATC.
5. Be alert for any progressive failure of attitude and navigation information sources.
6. Land as soon as practicable.

TURN AND SLIP INDICATOR FAILURE 1.8.1.7.10.2

A turn and slip indicator is part of the ADI display page. It is backed up by a stand-alone (the standby) turn and slip indicator located on the left side of the main instrument panel. In the rare event that both turn needle indicators fail, the pilot will have to use airspeed and bank angle to perform standard and 1/2 standard rate turns.

A total loss of the ADI display page, including the electronically displayed turn and slip indicator, is unlikely, unless associated with physical damage, a DEU failure, or an electrical power problem. An additional failure of the stand-alone turn and slip indicator is even more unlikely.

If a malfunction of the MFD turn and slip indicator is suspected:

- Check the indicator against the standby turn and slip indicator.
- Check the indicator against the ADI and standby AI bank indications.
- Check the indicator against rudder pedal position, and against the rudder trim position indicator.
- Check the indicator against any physical sensation of a slip.
- Check the DATA display page for any related OPGO/DEGD alerts.

If the ADI turn and slip indicator is inaccessible, or its indications are incorrect, modify your cross-check to include the standby turn and slip indicator.

There is no specific procedure for dealing with a simultaneous malfunction of both slip indicators, because that circumstance is very unlikely. Also, the impact of losing both sideslip indicators is not critical enough to warrant a prescribed remedial action.

The procedure for dealing with a failure of both turn and slip indicators is:

1. Check the ADI(s) to validate correct indications.
2. Be alert to possible electrical problems.
3. Use the ADI or standby AI (whichever is available) and airspeed indicator for controlling turn rate.

PROGRESS CHECK**Question 1 — 2.8.1.1.1**

If the GINA fails, which of the following is true?

- a) GINA OFF-flag appears on the ADI display page.
- b) AV BIT alert box appears on the ADI display page.
- c) AV BIT alert box appears on all MFD display pages.
- d) Position and airspeed data are lost.

ANSWER:

Question 2 — 1.8.1.7.12.2

In the event of an HSI position information failure and an associated AV BIT alert, what is a likely cause?

ANSWER:

Question 3 — 1.8.1.7.1.2

What is the most vital step in the ADI failure procedure?

- a) Use the standby attitude indicator and maintain aircraft control.
- b) Reset the ADI erect switch.
- c) Watch for possible progressive failure.
- d) Check the electrical system.

ANSWER:

Question 4 — 1.8.1.7.10.2

Which of the following steps apply when the turn and slip indicator fails?

- a) Use the ADI bank indices for rudder trim reference.
- b) Use the ADI and airspeed for turn rate reference.
- c) Check the ADI for correct indications.
- d) Be aware of possible electrical problems.

ANSWER:

PITOT STATIC MALFUNCTIONS 1.8.1.7.3.2

If the entire pitot static system fails, you will lose all airspeed, all barometric altitude, and all vertical velocity indicators in both cockpits. Verify the failure of any pitot static instrument by cross-checking indications between standby and MFD readouts, and with the other cockpit. A failure may result in frozen readouts, or zero readouts.

You can compensate for a total loss of the airspeed indications by flying the equivalent angle of attack for climb, cruise, descent, and landing. See the Performance Data section of NATOPS.

You have two ways to make up for the loss of barometric altitude information. First, you can use the radar altimeter for height above ground up to 5,000 ft AGL. Second, you can use the cabin pressure altimeter for altitude information. (Note: Regulations prohibit flight above 25,000 ft MSL if the cockpit has been depressurized). The cabin pressure altimeter does not compensate for local barometric pressure and should only be considered accurate to +/- 500 ft.

To compensate for a total loss of vertical velocity information, use the clock to time the amount of altitude change occurring over a specific period of time. For example, if you descend 200 ft in 15 seconds, your rate of descent is 800 ft per minute.

The procedure for dealing with a total pitot static system failure is:

1. Check PITOT HEAT -- ON.
2. Compare instruments in both cockpits. Use AOA, radar altimeter, and/or cabin pressure altimeter to calculate the approximate airspeed and altitude.
3. Report the failure to ATC.
4. Maneuver to exit icing conditions (if applicable).
5. Remain VMC, if possible.
6. Join with wingman if possible.
7. Consider declaring an in-flight emergency.

STANDBY AIRSPEED INDICATOR FAILURE 1.8.1.7.2.2

A standby airspeed indicator failure—by itself—is not a problem, providing airspeed information on the display system is still available and correct. If, however, both indication systems fail (or are in error), you may have to fly AOA in lieu of indicated airspeed for basic aircraft control. An extensive list of equivalent AOAs for the T-45C are listed in the Emergency Procedures section of NATOPS (main manual and pilot's pocket checklist). Some examples follow:

Takeoff	20 units (full flaps)
Climb	10-11 units
Maximum range	12-13 units
Approach	17 units

The procedure for dealing with a combined standby airspeed indicator failure, plus a display system airspeed failure is:

1. Check PITOT HEAT -- ON.
2. Report the failure to ATC.
3. Fly AOA in place of airspeed.
4. Be aware that display system navigation information that uses airspeed may be missing or incorrect.
5. Watch for other indications of pitot static system problems.
6. Land as soon as practicable.

STANDBY BAROMETRIC ALTIMETER FAILURE 1.8.1.7.9.2

You have two options to make up for the loss of the standby barometric altimeter. The system may or may not show proper altitude on display system altitude readouts.

First, you can use the radar altimeter for height above ground for altitudes up to 5,000 ft AGL. You must add ground elevation to radar altitude to approximate mean sea level (MSL) altitudes.

Second, you can obtain backup altitude information from the cabin pressure altimeter. This instrument should be considered accurate to +/-500 ft and is primarily useful at altitudes above 5,000 ft AGL, peak altitude for the radar altimeter. In order to use the cabin pressure altimeter above 5,000 ft MSL, you will have to depressurize the cockpit, and depressurized flight above 25,000 ft is prohibited.

Don't forget to cross-check your other pitot static system instruments (airspeed and vertical velocity indicator) to determine if they are operating correctly. The vertical velocity indication on the ADI display is generated by the GINA and is not affected by a pitot static system malfunction.

The procedure for dealing with a standby barometric altimeter failure that also includes display system barometric altitude readout failure is:

1. Check PITOT HEAT -- ON.
2. Report altimeter failure to ATC.
3. Use the radar and the cabin pressure altimeters to determine altitude (depressurize cockpit if required).

4. Be aware that the IFF altitude encoding signals may also be in error.
5. Land as soon as practicable.

STANDBY VSI FAILURE 1.8.1.7.8.2

If you lose all vertical velocity information (standby and display systems), use the clock to gauge the amount of altitude change occurring over a specific period of time. For example, if you descend 200 ft in 15 seconds, your rate of descent is 800 ft per minute. You can also use this procedure to check the accuracy of a suspect VSI.

It is important that you determine whether other instruments in the pitot static system are operating correctly. What may appear to be a stuck or erroneously indicating VSI could be part of a larger pitot static system problem.

NOTE: With a failed VSI and display system vertical velocity readout, your PAR approach capability is severely limited.

The procedure for dealing with a total VSI/vertical velocity readout failure is:

1. Check that PITOT HEAT -- ON.
2. Cross-check the altimeter and clock for a vertical velocity reference.
3. Check functionality of HUD velocity vector and use as appropriate aid.
4. Watch for other indications of possible pitot static problems.

PROGRESS CHECK

Question 5 — 1.8.1.7.3.2

Which of the following instruments may be affected by a pitot static malfunction?

- a) Airspeed indicator
- b) Barometric altimeter
- c) Vertical velocity
- d) Standby vertical speed indicator
- e) Angle of attack indicator

ANSWER:

PROGRESS CHECK**Question 6 — 1.8.1.7.2.2**

With failure of the airspeed indicator, fly _____ AOA to attain maximum range cruise.

- a) 17**
- b) 14**
- c) 12-13**
- d) 10-11**

ANSWER:

Question 7 — 1.8.1.7.9.2

When experiencing a suspected altimeter failure, which of the following are important considerations?

- a) You must add ground elevation to radar altitude to approximate MSL altitudes.**
- b) Depressurize the cockpit when using the cabin pressure altimeter.**
- c) Use the radar altimeters up to 5,000 ft AGL.**
- d) Recognize the possibility of an IFF altimeter error problem.**

ANSWER:

Question 8 — 1.8.1.7.8.2

With a failed VSI, you may cross-check the clock and altimeter to gauge vertical velocity. A 600 fpm vertical velocity is equivalent to:

- a) 200 ft change in 15 seconds**
- b) 300 ft change in 20 seconds**
- c) 200 ft change in 20 seconds**
- d) 150 ft change in 20 seconds**

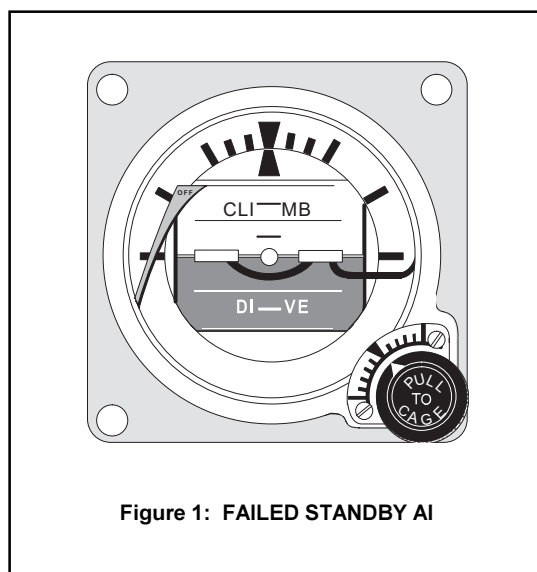
ANSWER:

STANDBY ATTITUDE INDICATOR FAILURE 1.8.1.7.6.2

As opposed to an ADI display system failure, a standby AI failure is not normally a significant problem. With this failure, you will lose the standby AI as a cross-check for the ADI display. Of course, if the ADI display has previously failed or if its indications are also suspect, a standby AI failure becomes a serious matter, especially, when IFR/IMC.

Figure 1 shows one of the possible indications of a failed standby AI. The power-off flag does not have to be present for the indicator to give a false reading because the flag signifies only a lack of electrical power.

NOTE: After loss of power with the power-off flag in view, the 2" standby AI will continue to provide reliable attitude reference for up to 9 minutes after failure.



The procedure for dealing with a standby AI failure is:

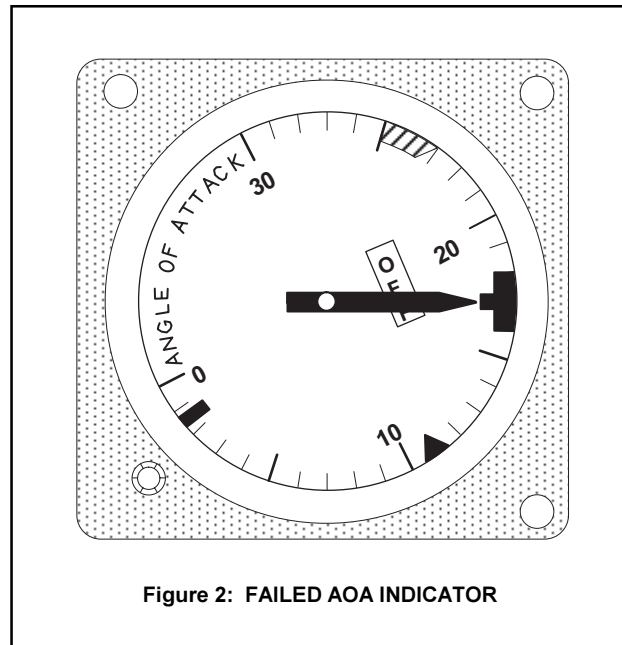
1. Use the MFD ADI display.
2. Check the electrical system.
3. Watch for possible progressive failure of other instruments or systems.

AOA INDICATOR FAILURE 1.8.1.7.4.2

Loss of only the AOA gauge indicator is not a significant problem, so long as you are still able to read correct AOA digital information on the MFDs and HUD. If both the AOA indicator and digital AOA readouts have failed (or become incorrect), the pilot will have to fly airspeed instead of AOA. The cockpit AOA indexer lights may still be

available. Be aware that in some AOA failure situations, the AOA approach lights will also become either inoperative or signal incorrect readings to the ground observer/LSO.

Figure 2 shows one possible indication of a failed AOA indicator: an OFF flag. The OFF flag does not have to be present for the indicator to give false readings because it indicates only a lack of electrical power.



The procedure for dealing with a total AOA readout failure is:

1. Use the airspeed indicator.
2. Fly calculated approach speeds, using the airspeed indicator.
3. Inform Tower/Approach/LSO (as appropriate) in case the aircraft's AOA approach lights have been affected.

RADAR ALTIMETER FAILURE 1.8.1.7.11.2

With a failed radar altimeter, you lose your height-above-ground reference. The only cockpit radar altimeter readouts are in a digital format on the HUD and MFD displays. If you are aware of your location and the local terrain, the danger is minimal. If you have any doubt about your position or the topography of the surrounding area, you should notify the controlling agency and immediately climb to a safe altitude. This is particularly true at night and during IMC.

Once you are sure of the local surface elevation and have confirmed that the barometric altimeter has the correct setting, you should be able to use it for all altitude references.

However, the radar altimeter supplies height above terrain, whereas the barometric altimeter gives you height above sea level.

The procedure for dealing with a radar altimeter failure is:

1. Use the barometric altimeter.
2. Confirm the correct altimeter setting.

PROGRESS CHECK

Question 9 — 1.8.1.7.6.2

Which of the following steps should be employed when dealing with failure of the standby AI?

- a) Reset the standby gyro inverter.**
- b) Use the ADI display.**
- c) Check the electrical system.**
- d) Watch for possible progressive failure.**

ANSWER:

Question 10 — 1.8.1.7.4.2

The correct procedure for dealing with an AOA indicator failure is to fly _____ instead of angle of attack.

ANSWER:

Question 11 — 1.8.1.7.11.2

Which of the following situations might cause the radar altimeter "OFF" flag to appear?

- a) Power failure**
- b) System turned off**
- c) Aircraft attitude greater than +/- 40 degrees pitch or roll**
- d) There is no radar altimeter indicator or "OFF" flag.**

ANSWER:

VOR FAILURE 1.8.1.9.8.2

Once a selected NAV control panel (FWD/AFT command on the HSI MFD) is turned on and a valid VOR frequency is selected, VOR feeds data to the DEU.

Until a tuned VOR station is locked-on and the CDI mode is selected, there will be no VOR indications shown on the HSI display system: no digital bearing data, no bearing pointer, no CDI, no alert notices. Once a VOR lock-on occurs, digital VOR bearing information is displayed in the upper left-hand corner of the HSI preceded by a “V,” and a VOR bearing pointer and tail is displayed on the HSI compass card. If VOR steering mode is also selected [VOR boxed], the VOR CDI will also be displayed. A selected VOR station must be within range before the system can lock-on, and the pilot must be in the CDI mode.

The T-45C system is designed so that a VOR station may be tuned anytime, and kept in the ON position without entailing a cockpit distraction. When within range of a tuned station, it will lock-on and VOR data will be displayed—but, only in CDI mode.

If a locked-on VOR fails, the aural identification tone will be lost. The digital “V” and digital bearing data will be removed. The VOR bearing pointer will no longer be displayed, and if VOR steering had been previously selected, the CDI will go away. Unlike most analog systems, no VOR warning “flags” appear on the HSI display if the VOR fails or breaks lock.

The procedure for dealing with a VOR failure is:

1. Reset the desired frequency.
2. Cycle the NAV control panel to OFF and back to PWR.
2. Check with ATC to see if the subject VOR is in operation, or select another VOR that is known to be in operation and within range.
3. Use TACAN [if available], waypoints [non-IFR conditions], or request radar vectors.

TACAN BEARING/DME FAILURE 1.8.1.9.4.2

Once a selected TACAN control panel (FWD/AFT command on the HSI MFD) is turned on and a valid TACAN station is selected, the TACAN feeds data to the DEU.

Until a tuned TACAN station locks-on, there will be no TACAN data shown on the HSI display page: no digital bearing data, the bearing pointer will rotate in a search mode, no DME, and no TACAN symbol. Once the TACAN locks-on, TACAN bearing, slant-range DME, and slant-range time-to-go will be digitally displayed in the upper left-hand corner of the HSI page. The TACAN bearing pointer will lock-on and point to the TACAN station and the TACAN symbol will be displayed. If TACAN is selected as the

steering mode, a TACAN course line, CDI or Planimetric, will also be displayed. The T-45C display system is designed so that a TACAN channel may be tuned anytime, and the TACAN kept in the ON position without causing a cockpit distraction. When within range, the system will lock-on. If a properly tuned TACAN fails, the aural identification tone will be lost. Unlike many analog systems, no TACAN warning “flags” will appear on the HSI display.

If the bearing information fails after lock-on, the TACAN digital bearing readout, the bearing pointer, and TACAN symbol will be removed. If the TACAN has only lost its lock-on, the digital bearing readout and TACAN symbol will still disappear, but the TACAN bearing pointer will rotate in a search mode. If a valid DME signal is lost or the DME fails, all digital DME and the TACAN symbol will be removed until return of a valid signal, and the CDI will go away.

(NOTE: For computation of digital TACAN time-to-go, the system uses whatever GS is being computed at that precise moment on the existing aircraft heading. That resulting GS will not necessarily be the same GS that would result after turning the aircraft to proceed directly to the TACAN station. Depending on relative bearing of the TACAN station and the actual wind direction/velocity, the GS and time-to-go computation may be significantly different than those that are correct for a direct flight to the TACAN station.)

The procedure for dealing with TACAN bearing/DME failure is:

1. Reset the desired channel.
2. Cycle the TACAN control panel to OFF and back to ON.
3. Check with ATC to determine if the subject TACAN is in operation, or select another TACAN that is known to be in operation and within range.
4. Use VOR (if available), waypoints (non-IFR conditions), or request radar vectors.

ILS GLIDESLOPE FAILURE 1.8.1.9.9.2

The FWD/AFT selection made on the HSI MFD determines which NAV radio control head is active. The frequency entered by the pilot will automatically direct the HSI MFD to display an ILS or VOR legend.

Like VOR, ILS is only available and can only be selected in the HSI CDI mode. Once ILS steering has been selected in the CDI mode, changing to HSI PLAN mode will cause removal of the ILS course line and ILS CDI bar, but ILS steering needles will continue to be displayed on both the HUD and ADI.

Loss of a valid ILS glideslope is signaled by appearance of the GLIDESLOPE advisory box, and the glideslope needle on the ADI and HUD will become blanked. In that circumstance, the pilot may elect to continue flying an ILS, but to a localizer-only; totally discontinue the ILS approach; or transition to another type approach (VOR, TACAN, PAR, ASR, VFR) depending upon the situation, availability, and location. If you change to another type IFR approach, the approach minimums will probably change.

ILS LOCALIZER FAILURE 1.8.1.9.10.2

The FWD/AFT selection made on the HSI MFD determines which NAV control head is active. The frequency entered by the pilot automatically determines whether the HSI MFD displays an ILS or VOR legend.

Like VOR, ILS is only available and can only be selected in the HSI CDI mode. Once ILS steering has been selected in the CDI mode, changing to HSI PLAN mode will cause removal of the ILS course line and ILS CDI bar, but ILS steering needles will continue to be displayed on both the HUD and ADI.

Loss of a valid ILS localizer is signaled by appearance of the LOCALIZER advisory box and disappearance of the glideslope and localizer needles on the ADI and HUD. In that circumstance, the pilot must abort the ILS and transition to another type approach (VOR, TACAN, PAR, ASR, VFR). If the type IFR approach changes, the IFR approach minimums will probably change.

ILS MARKER BEACON FAILURE 1.8.1.9.11.2

If an outer marker is incorporated in an approach, which is not always the case, the ILS final approach fix (FAF) will be coincidental with that OM. If you lose the OM, you may still be able to complete an ILS approach. It is allowable if the ILS approach plate also gives TACAN/DME, radar, or TACAN crossing radials for determining the FAF from which descent to MDA and missed approach timing are commenced, or missed approached is also denoted with a DME.

According to the FAA, middle marker (MM) beacons are no longer required for ILS or localizer-only approaches. Nonetheless, many MM beacons are still indicated on ILS plates. The FAA says that they should be considered information-only assets. The MM may—or may not—be positioned coincidentally with the published missed approach point: ILS or localizer-only.

The missed approach point on a localizer-only ILS—depending on the subject approach plate—may be identified with a TACAN/DME mileage in addition to stopwatch timing to/from the FAF. According to the FAA, ILS localizer-only missed approach points should not be “identified” only by means of a MM beacon; however, a MM may be depicted on published approaches. These MMs may, or may not, be collocated with missed approach points. (Note: If a MM is coincident with the localizer-only missed approach point, the pilot should execute a missed approach if the MM beacon illuminates prior to expiration of timing from the FAF).

Any alternate means [in addition to timing from a FAF] used to determine a localizer-only missed approach point should be clearly published on the approach plate; approximation and guessing are not allowed.

If for whatever reasons you switch to another type IFR approach, your IFR approach minimums may change. Stay alert.

PROGRESS CHECK

Question 12 — 1.8.1.9.8.2

In the event of a VOR failure, you should first cycle the frequency selector and check with ATC to see if the station is in operation. If the failure is not corrected, you should then use _____.

ANSWER:

Question 13 — 1.8.1.9.4.2

In the event of TACAN bearing failure, you should first cycle the channel selector and TACAN receiver. If that does not restore TACAN operation, what should you do next?

ANSWER:

PROGRESS CHECK**Question 14 — 1.8.1.9.9.2**

One of the options you have in dealing with an ILS glideslope failure is to

- a) check to see if the station is in operation.
- b) downgrade the approach to a localizer only.
- c) declare an emergency.
- d) use the CDI.

ANSWER:

Question 15 — 1.8.1.9.10.2

The correct procedure for dealing with an ILS localizer failure that occurs while flying the approach is to

- a) reset the ILS circuit breaker.
- b) discontinue flying the ILS approach.
- c) declare an emergency.
- d) switch to VOR and continue.

ANSWER:

Question 16 — 1.8.1.9.11.2

In the event of an ILS marker beacon failure, you may continue the approach, provided you can use published _____, _____, or _____, to identify the FAF.

ANSWER:

FLIGHT WITH PARTIAL PANEL 2.7.4.1.1

All flight maneuvers remain the same whether you are flying under full or partial panel conditions. In the T-45C, partial panel flight consists of flying without the ADI display. In the event that the ADI display fails, you will have to substitute the standby AI and other standby instruments. If you have lost all MFD information, follow the procedures described in that section of this workbook.

Substituting the standby AI for the ADI display will require you to change your normal scan pattern. Be careful not to fixate on the standby AI because of its unfamiliar location and the resulting change in your scan pattern.

You may find it more difficult to exercise fine aircraft control because of the standby AI's smaller (2-inch) size. It will move a smaller distance for a given control input even though the actual attitude indications are the same. Unlike the MFD display, the standby AI provides only nose and wing attitude information.

COMMON ERROR: Be careful not to overcontrol the aircraft. The small size and different location of the standby AI may cause you to rely more on the performance instruments than you would under full panel conditions, so you may tend to "chase" your remaining performance instruments.

PROGRESS CHECK**Question 17 - 2.7.4.1.1**

For partial panel flight, substitute the _____ for the ADI display.

ANSWER:

SUMMARY

This lesson has focused on the procedures for:

- * MFD display failure
- * HSI failure
- * ADI failure
- * Turn and slip indicator failure
- * Pitot static malfunctions
- * Standby airspeed indicator failure
- * Standby barometric altimeter failure
- * Standby VSI failure
- * Standby AI failure
- * AOA indicator failure
- * Radar altimeter failure
- * VOR failure
- * TACAN bearing/DME failure
- * ILS glideslope failure
- * ILS localizer failure
- * ILS marker beacon failure
- * Partial panel flight

CONCLUSION

If you understand the procedures and scans to use in the event of instrument failures, you will be more comfortable and confident when flying instruments.

ANSWER KEY

Question 1 — 2.8.1.1.1

If the GINA fails, which of the following is true?

- a) GINA OFF-flag appears on the ADI display page.
- b) AV BIT alert box appears on the ADI display page.
- c) AV BIT alert box appears on all MFD display pages.
- d) Position and airspeed data are lost.

ANSWER: c

Question 2 — 1.8.1.7.12.2

In the event of an HSI position information failure and an associated AV BIT alert, what is a likely cause?

ANSWER: GINA failure

Question 3 — 1.8.1.7.1.2

What is the most vital step in the ADI failure procedure?

- a) Use the standby attitude indicator and maintain aircraft control.
- b) Reset the ADI erect switch.
- c) Watch for possible progressive failure.
- d) Check the electrical system.

ANSWER: a

Question 4 — 1.8.1.7.10.2

Which of the following steps apply when the turn and slip indicator fails?

- a) Use the ADI bank indices for rudder trim reference.
- b) Use the ADI and airspeed for turn rate reference.
- c) Check the ADI for correct indications.
- d) Be aware of possible electrical problems.

ANSWER: b, c, d

Question 5 — 1.8.1.7.3.2

Which of the following instruments may be affected by a pitot static malfunction?

- a) Airspeed indicator
- b) Barometric altimeter
- c) Vertical velocity
- d) Standby vertical speed indicator
- e) Angle of attack indicator

ANSWER: a, b, d

Question 6 — 1.8.1.7.2.2

With failure of the airspeed indicator, fly _____ AOA to attain maximum range cruise.

- a) 17
- b) 14
- c) 12-13
- d) 10-11

ANSWER: c

Question 7 — 1.8.1.7.9.2

When experiencing a suspected altimeter failure, which of the following are important considerations?

- a) You must add ground elevation to radar altitude to approximate MSL altitudes.
- b) Depressurize the cockpit when using the cabin pressure altimeter.
- c) Use the radar altimeters up to 5,000 ft AGL.
- d) Recognize the possibility of an IFF altimeter error problem.

ANSWER: a, b, c

Question 8 — 1.8.1.7.8.2

With a failed VSI, you may cross-check the clock and altimeter to gauge vertical velocity. A 600 fpm vertical velocity is equivalent to:

- a) 200 ft change in 15 seconds
- b) 300 ft change in 20 seconds
- c) 200 ft change in 20 seconds
- d) 150 ft change in 20 seconds

ANSWER: c

Question 9 — 1.8.1.7.6.2

Which of the following steps should be employed when dealing with failure of the standby AI?

- a) Reset the standby gyro inverter.
- b) Use the ADI display.
- c) Check the electrical system.
- d) Watch for possible progressive failure.

ANSWER: b, c, d

Question 10 — 1.8.1.7.4.2

The correct procedure for dealing with an AOA indicator failure is to fly _____ instead of angle of attack.

ANSWER: airspeed

Question 11 — 1.8.1.7.11.2

Which of the following situations might cause the radar altimeter "OFF" flag to appear?

- a) Power failure
- b) System turned off
- c) Aircraft attitude greater than +/- 40 degrees pitch or roll
- d) There is no radar altimeter indicator or "OFF" flag

ANSWER: d

Question 12

In the event of a VOR failure, you should first cycle the frequency selector and check with ATC to see if the station is in operation. If the failure is not corrected, you should then use _____.

ANSWER: An alternate approach which could be TACAN PAR/ASR or visual

Question 13

In the event of TACAN bearing failure, you should first cycle the channel selector and TACAN receiver. If that does not restore TACAN operation, what should you do next?

ANSWER: Check with ATC to see if the station is still in operation.

Question 14

One of the options you have in dealing with an ILS glideslope failure is to

- a) check to see if the station is in operation.
- b) downgrade the approach to a localizer only.
- c) declare an emergency.
- d) use the CDI.

ANSWER: b

Question 15

The correct procedure for dealing with an ILS localizer failure that occurs while flying the approach is to

- a) reset the ILS circuit breaker.
- b) discontinue flying the ILS approach.
- c) declare an emergency.
- d) switch to VOR and continue.

ANSWER: b

Question 16

In the event of an ILS marker beacon failure, you may continue the approach, provided you can use published _____, _____, or _____, to identify the FAF.

ANSWER: TACAN/DME, radar, crossing radials

Question 17

For partial panel flight, substitute the _____ for the ADI display.

ANSWER: standby AI

NOTES